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| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.             | CONFIRMATION NO. |
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| 10/657,741  | 09/08/2003  | Lawrence E. Felton   | 2550/176                        | 8927             |
| 7590 07/07/2004   |             |                      |                                 |                  |
| Steven G. Saunders<br>Bromberg & Sunstein LLP<br>125 Summer Street<br>Boston, MA 02110-1618 |             |                      | EXAMINER<br>LARKIN, DANIEL SEAN |                  |
|   |             |                      | ART UNIT<br>2856                | PAPER NUMBER     |

DATE MAILED: 07/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

*AK*

|                              |                                      |                                      |  |
|------------------------------|--------------------------------------|--------------------------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/657,741 | <b>Applicant(s)</b><br>FELTON ET AL. |  |
|                              | <b>Examiner</b><br>Daniel S. Larkin  | <b>Art Unit</b><br>2856              |  |

-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 September 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____.  |

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to because of the following:

The drawings are hard to interpret due to the darkness of the figures. With respect to Figures 3 and 8A-8D, one cannot determine where some of the lead lines are pointing to because the figures are so dark as to obscure the lead lines.

Some figures, such as Figures 4 and 5, appear formal, whereas other figures appear to be informal. Some consistency in the presentation of the drawing figures is appropriate.

Reference to Figure 4 appears to suggest a single sensor; however, the disclosure, page 7, lines 23-25, discloses that Figure 4 is representative of a plurality of sensors. Correction of either Figure 4 or the disclosure appears necessary for consistency of the disclosure with the corresponding drawing figures.

Some consistency is needed in which words are capitalized in Figure 5.

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference character(s) mentioned in the description:

Reference numeral -- 26 -- is not shown with respect to Figure 3, as suggested by the disclosure on page 6, line 19.

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3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "one flip-chip bond pad connecting the die to the interconnect substrate, as well as being connected to the cap" as claimed in claim 19 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

4. Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Specification***

5. The disclosure is objected to because of the following informalities:

Page 4, lines 12, 15, 17, 19, 21, 23, and 26: The term "figure" should be corrected to read -- Figure --.

Page 5, line 10: The term "figure" should be corrected to read -- Figure --.

Page 6, lines 1 and 18: The term "figure" should be corrected to read -- Figure --.

Page 7, lines 23, 24, and 25: The term "figure" should be corrected to read -- Figure --.

Page 8, line 15: The term "figures" should be corrected to read -- Figures --.

Page 8, lines 18 and 19: The term "figure" should be corrected to read -- Figure --.

Page 11, lines 3, 6, 8, and 22: The term "figure" should be corrected to read -- Figure --.

Page 11, line 3: The term "figures" should be corrected to read -- Figures --.

Page 12, lines 1, 4, and 20: The term "figure" should be corrected to read -- Figure --.

Page 12, line 13: The term "act" should be corrected to read -- acts --.

Page 13, line 3: The term "figure" should be corrected to read -- Figure --.

Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 2, 4-6, and 9 are rejected under 35 U.S.C. 102(e) as being anticipated by US 2004/0077154 (Nagarajan et al.).

With respect to the limitations of claim 1, the reference to Nagarajan et al. discloses a wafer-level package for micro-electro-mechanical systems comprising in one embodiment, as shown in Figures 3A-3G, a sensor having a die/wafer (372) with a working portion; a cap wafer (352) coupled with the die/wafer (372) to at least partially cover the working portion, see Figure 3G; and a conductive pathway (354, 362) extending through the cap wafer (352) to the working portion, the pathway providing an electrical interface to the working portion, page 4, paragraph [0037], lines 6-13.

With respect to the limitations of claim 2, the reference to Nagarajan et al. discloses the working portion of the die/wafer (372) includes MEMS structure (374), the conductive pathway (354, 362) capable of transmitting electrical signals relating to the operation of the MEMS structure, page 4, paragraph [0037], lines 6-13.

With respect to the limitation of claim 4, the reference to Nagarajan et al. discloses that a chamber/MEMS cavity (370) is formed through the connection of the

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die/wafer (372) and the cap wafer (352) such that the cavity (370) sealingly contains the working portion of the die/wafer (372).

With respect to the limitations of claim 5, the reference to Nagarajan et al. shows that the cap wafer (352) has a top surface, the conductive pathway (354) extends through the cap (32) to the top surface, the conductive pathway (354) being exposed on the top surface, see Figures 3B, 3D, and 3E.

With respect to the limitation of claim 6, the reference to Nagarajan et al. discloses in the background of the invention that one of the most popular MEMS devices is an accelerometer, page 1, paragraph [0006].

With respect to the limitation of claim 9, the reference to Nagarajan et al. discloses that the Frit glass (378) is used to hermetically seal the wafer-level MEMS package, page 6, paragraph [0065], lines 1-8.

8. Claims 1-5, 8-10, and 18-20 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6,633,079 (Cheever et al.).

With respect to the limitations of claim 1, the reference to Cheever et al. discloses a wafer level interconnection comprising a sensor having a die/substrate (17) with a working portion; a cap/dielectric lid (19) coupled with the die/substrate (17) to at least partially cover the working portion; and a conductive pathway (35, 37) extending through the cap/dielectric lid (19) to the working portion, the pathway providing an electrical interface to the working portion, col. 2, lines 50-57.

With respect to the limitations of claim 2, the reference to Cheever et al. discloses the working portion of the die/substrate (17) includes MEMS structure, (see claim 9), the conductive pathway (35, 37) capable of transmitting electrical signals relating to the operation of the MEMS structure, col. 2, lines 50-57.

With respect to the limitation of claim 3, the reference to Cheever et al. discloses that the working portion includes circuitry (15).

With respect to the limitation of claim 4, the reference to Cheever et al. discloses that a chamber/gap (21) is formed through the connection of the die/substrate (17) and the dielectric lid (19) such that the gap (21) sealingly contains the working portion of the die/substrate (17).

With respect to the limitations of claim 5, the reference to Cheever et al. shows that the dielectric lid (19) has a top surface, the conductive pathway (35, 37) extends through the lid (19) to the top surface, the conductive pathway (35, 37) being exposed on the top surface.

With respect to the limitations of claim 8, the reference to Cheever et al. further discloses an electrical interconnect substrate (13) having at least one circuit element (11), the die/substrate (17) and cap/dielectric lid (19) together forming a capped die, the capped die being coupled to the substrate (13) so that the conductive path (35, 37) contacts the substrate (13) to interconnect with the at least one circuit element (11).

With respect to the limitation of claim 9, the reference to Cheever et al. discloses that the dielectric lid (19) is used to seal the circuitry (15) within the gap (21).



With respect to the limitation of claim 10, the reference to Cheever et al. discloses that the working portion of the die/substrate (17) includes both MEMS structure (see claim 9) and circuitry (15) for at least in part detecting movement of the MEMS structure. The reference discloses that the MEMS structure is a switch which moves from one position to another position.

With respect to the limitations of claim 18, the reference to Cheever et al. discloses a sensor comprising a die/substrate (17) having a working portion, the working portion having movable structure and circuitry (15) for detecting movement of the movable structure; a flip-chip bond pad/solder ball (27, 43) electrically coupled (25, 41) with the circuitry (15); and an electrical interconnect substrate/printed circuit board (not shown), the die/substrate (17) being flip-chip bonded to the substrate/board via the flip-chip bond (27, 43), col. 2, lines 62-67 through col. 3, lines 1-26.

With respect to the limitations of claim 19, the reference to Cheever et al. discloses a cap/dielectric lid (19) at least partially covering the working portion, a flip-chip bond pad (30) being secured to the cap/dielectric lid (19).

With respect to the limitation of claim 20, the reference to Cheever et al. further discloses a conductive pathway (25, 37) extending through the cap/dielectric lid (19) from the flip-chip bond pad (30) to the circuitry (15).

### ***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2004/0077154 (Nagarajan et al.) in view of US 2003/0038327 (Smith).

With respect to the limitation of claim 7, the reference to Nagarajan et al. discloses all of the limitations of claim 1. The reference to Nagarajan et al. fails to disclose that the MEMS structure gyroscope. The reference to Smith discloses a hermetically sealed silicon micro machined electromechanical system device whereby the reference discloses that the MEMS sensor may include an acceleration sensor, filter, a pressure sensor, or a gyroscope. Providing a MEMS sensor comprising a gyroscope would have been obvious to one of ordinary skill in the art given that MEMS devices are well known in their use in detecting motion and forces in tight enclosures and gyroscopes are well-known MEMS sensor as disclosed by Smith.

11. Claims 11, 12, 15, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 2004/0077154 (Nagarajan et al.) in view of US 6,448,109 (Karpman).

With respect to the limitations of claim 11, the reference to Nagarajan et al. discloses a wafer level package for micro-electro-mechanical systems comprising creating a sensor through the method of forming a working portion (574) on a first wafer (572); forming a plurality of through holes (554) and a cavity (570) on a second

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wafer/cap wafer (552); securing the second wafer (552) to the first wafer (572), at least one of the cavity (570) aligning with a working portion (574); and filling the through holes (574) with conductive material (562) to provide a plurality of conductive paths. The reference to Nagarajan et al. fails to disclose creating a plurality of sensors and dicing the first and second wafers to create a plurality of sensors. The reference to Karpman discloses a wafer level method of capping multiple MEMS elements whereby a plurality of working portions (14) are attached to a first wafer (12), a plurality of second wafers/caps (6) are attached to a template (2); the plurality of caps (6) are brought into sealing contact with the first wafer (12) such that a cavity is formed around the each working portion formed on the first wafer (12). The reference further discloses that the MEMS wafer 12 is then diced into individual completed MEMS chips along dice lines (20). Creating a plurality of MEMS chips would have been obvious to one of ordinary skill in the art as a means of more cheaply producing the chip by creating them in mass which reduces material costs and material waste.

With respect to the limitation of claim 12, the reference to Nagarajan et al. discloses that an electroless plating step (510) is performed to filled the through holes (574) with a conductive material (562), such as nickel.

With respect to the limitation of claim 15, the reference to Nagarajan et al. discloses that the conductive material (562) contacts the working portion through a MEMS pad (579).

With respect to the limitation of claim 17, dicing of the MEMS chips creates a MEMS sensor structure.

12. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2004/0077154 (Nagarajan et al.) in view of US 6,448,109 (Karpman) as applied to claim 11 above, and further in view of US 6,384,353 (Huang et al.).

With respect to the limitation of claim 13, the reference to Nagarajan et al. discloses using Frit glass to seal the cap to the MEMS wafer. The reference to Nagarajan et al. fails to disclose using a screen printed glass. The reference to Huang et al. discloses that the Prior Art teaches the uses of a screen print of glass used to separate the cap from a MEMS wafer. Using glass to seal the wafers together would have been obvious to one of ordinary skill in the art because glass is not porous which helps to hermitically seal the MEMS device. Additionally, glass has a similar coefficient of expansion as silicon substrates which are used to hold the MEMS device.

13. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2004/0077154 (Nagarajan et al.) in view of US 6,448,109 (Karpman) as applied to claim 11 above, and further in view of US 2003/0038327 (Smith).

With respect to the limitations of claim 14, the reference to Nagarajan et al. discloses all of the limitations of claim 11. The reference to Nagarajan et al. discloses that the MEMS structure (574) comprises a movable member (576); however, the reference fails to expressly disclose that the MEMS structure contains accelerometers or gyroscopes. The reference to Smith discloses a hermetically sealed silicon micro machined electromechanical system device whereby the reference discloses that the MEMS sensor may include an acceleration sensor, filter, a pressure sensor, or a

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gyroscope. Providing a plurality of MEMS sensors containing accelerometers or gyroscopes would have been obvious to one of ordinary skill in the art given that MEMS devices are well known in their use in detecting motion and forces in tight enclosures and accelerometers and gyroscopes are well-known MEMS sensor as disclosed by Smith.

14. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 2004/0077154 (Nagarajan et al.) in view of US 6,448,109 (Karpman) as applied to claim 11 above, and further in view of US <sup>6,633,079</sup><sub>A</sub> (Cheever et al.).

With respect to the limitation of claim 16, the reference to Karpman discloses placing a MEMS structure (14) and circuitry (28) within the cavity used to seal the MEMS structure (14). The reference to Karpman and Nagarajan et al. both fail to disclose a working portion containing both a MEMS structure and circuitry. The reference to Cheever et al. discloses the working portion of the die/substrate (17) includes MEMS structure, (see claim 9) as well as circuitry (15). Providing circuitry with the structure would have been obvious to one of ordinary skill in the art as a means of minimizing the size of the sensor by eliminating the need to provide an external circuit or a separate substrate to carry the circuit.

***Conclusion***

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The prior art US 6,429,511 (Ruby et al.) discloses a microcap wafer-level package comprising a MEMS wafer, a cap, and conductive through holes through the cap.

The prior art to US 6,559,530 (Hinzl et al.) discloses a method of integrating MEMS device with low-resistivity silicon substrates comprising forming a MEMS substrate, forming a cap, creating conductive through holes through the cap, and connecting the cap to the MEMS wafer.

The prior art to US 6,512,300 (Cheever et al.) is the parent application/patent to the Cheever et al. reference cited above in the claim rejections.


16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel S. Larkin whose telephone number is 571-272-2198. The examiner can normally be reached on 8:00 AM - 5:00 PM Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hezron Williams can be reached on 571-272-2208. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Daniel Larkin  
AU 2856  
05 July 2004



**DANIEL S. LARKIN**  
**PRIMARY EXAMINER**